1.)

a.) Two relevant Events?

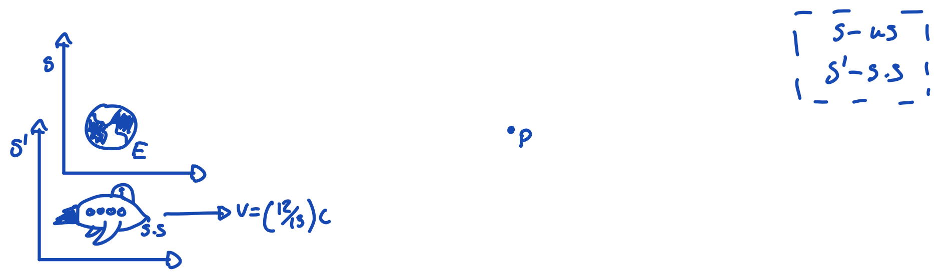
E_1 = The S.S departs Earth

E_2 = S.S travels for one hour RT S.S

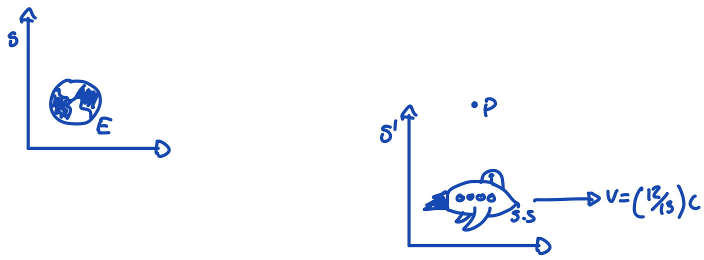
S.S observer measures $\Delta x' = 0$

b.) Draw two Images

$\underline{E_1}$



$\underline{E_2}$



C.) What does our stopwatch read

$\Delta t' = 1\,hr$ $\quad \Delta t = \dfrac{\Delta t'}{\sqrt{1 - v^2/c^2}} = \dfrac{1\,hr}{\sqrt{1 - (12/13)^2 c}} = \dfrac{13}{5}\,hr = 2.6\,hr$

$t_{us} = 2.6\,hr$

d.) How much distance traveled for S.S

$D = v \cdot \Delta t$

$v = (12/13)c$ $\quad D = (12/13)c\,(13/5)\,hr = 2.4\,c \cdot hr$

$\Delta t = (13/5)\,hr$

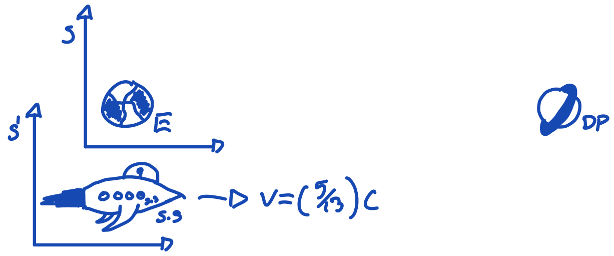
$D = 2.4\,c \cdot hr$

e.) Distance RT to S.S?

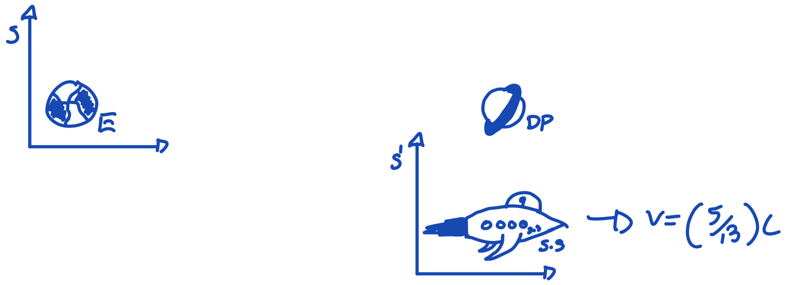
$d = D\sqrt{1 - v^2/c^2} = 2.4\,c \cdot hr\sqrt{1 - (12/13)^2} = 2.4\,c \cdot hr\,(5/13) = (12/13)\,c \cdot hr$

$D = 0.92\,c \cdot hr$

2.) $\underline{E_1}$



$\underline{E_2}$



a.) How much time passed on DP Clock?

$D = 25\ c\cdot yrs$

$v = (5/13)c$

$$\Delta t = \frac{D}{v} = \frac{25\ c\cdot yrs}{(5/13)c} = 65\ yrs$$

$t_{DP} = 65\ yrs$

b.) How much time passed on spaceship clock?

$$\Delta t' = \Delta t \cdot \sqrt{1 - v^2/c^2} = 65\ yrs \sqrt{1-(5/13)^2} = 65\ yrs\,(12/13) = 60\ yrs$$

$t_{SS} = 60\ yrs$

c.) How far apart RT SS Frame?

Acc. to S.S: $t = 60\ yrs$, $v = (5/13)c$

$D = v\cdot\Delta t = 60\ yrs\,(5/13)c = 23\ c\cdot yrs$

$d = 25\ c\cdot yrs\sqrt{1-(5/13)^2} = 23\ c\cdot yrs$

$D_{SS} = 23\ c\cdot yrs$

3.)

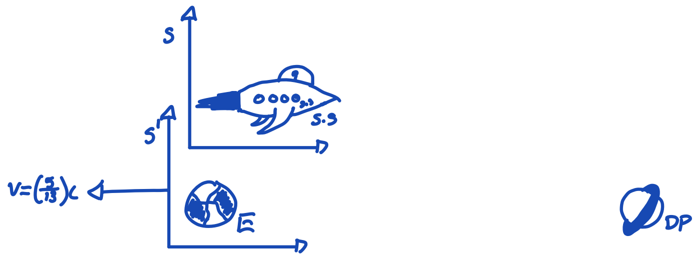
a.) The two relevent events are

E_1 - When The Earth departs the S.S

E_2 - When The Distant Planet arrives at the S.S

The observers on Earth and the Distant Planet measure $\Delta x' = 0$

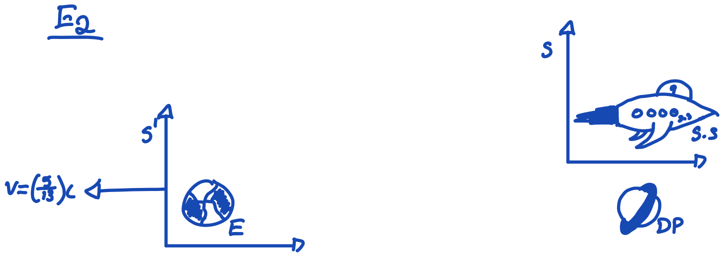
b.) E_1



S - S.S

S' - Earth and DP

E_2



c.) The rest length between the two events...

S.S sees distance between as $d = 23$ c·yrs

Since the Earth and DP are moving RT S.S,

this distance will conctract for the events.

$$d = D\sqrt{1 - v^2/c^2} = 23\,c\cdot yrs\sqrt{1 - \left(\tfrac{5}{13}\right)^2} = 23\,c\cdot yrs\left(\tfrac{12}{13}\right) = 21.2\ c\cdot yrs$$

$d = 21$ c·yrs

S.S measures this

d.) what does Earth's clock read RT S.S

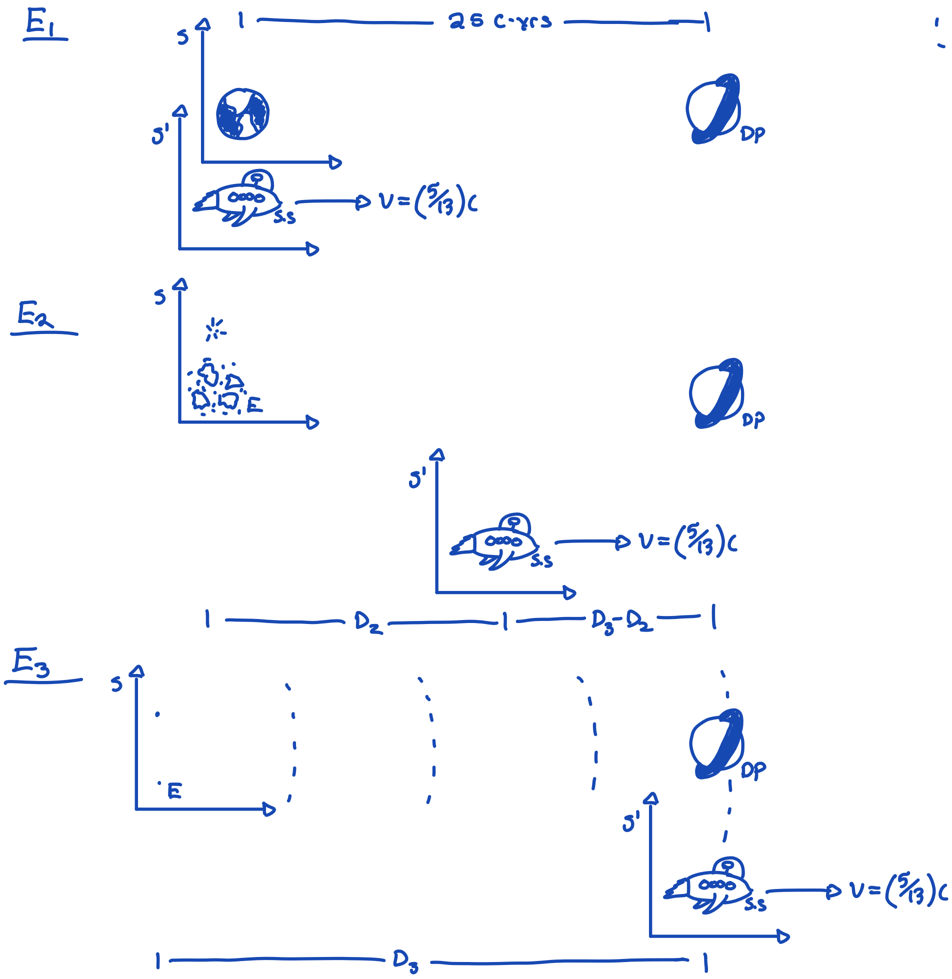
$$d = 21\ c\cdot yrs \qquad \Delta t = D/v = \frac{21\,c\cdot yrs}{(5/13)} = 54.6\ yrs$$

$t_{S.S} = 55$ yrs

4.)

a.) Three sets of pictures,

S- Earth and DP
S'- S.S



b.) D_3 can be defined as . . . .

$D_3 = v \cdot t_3$

$D_3 = v \cdot t_2 + v(t_3 - t_2)$

$D_3 = c(t_3 - t_2)$

$$t_3 = \frac{D_3}{v} = \frac{25\ c\cdot yrs}{(5/13)c} = 65\ yrs$$

$c(t_3 - t_2) = vt_2 + v(t_3 - t_2)$

$ct_3 - ct_2 = vt_2 + vt_3 - vt_2$

$ct_3 - vt_3 = vt_2 + ct_2 - vt_2$

$ct_3 - vt_3 = ct_2$

$t_2 = t_3 - \frac{v}{c} t_3$

$t_2 = t_3(1 - v/c) = 65 yrs(1 - 5/13) = 65 yrs(8/13) = 40$ years

$t_E = 40$ yrs

c.) $\Delta t' = \Delta t \cdot \sqrt{1 - v^2/c^2} = 40 yrs \sqrt{1 - (5/13)^2} = 40 yrs(12/13) = 37$ years

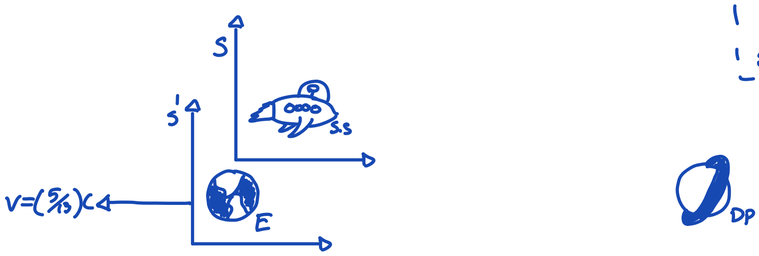
$t_{ss} = 37$ yrs

5.)

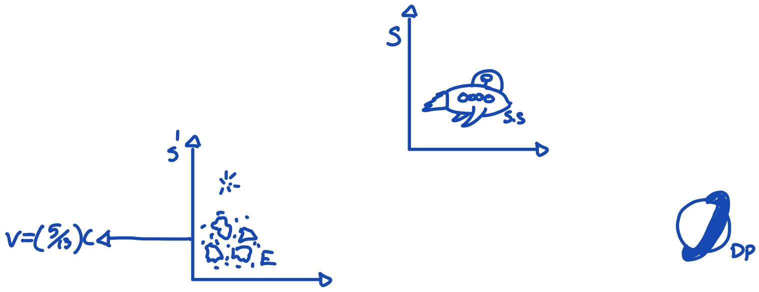
a.) Draw three pics RT rest frame of S.S

| S - S.S |
| S' - Earth and DP |

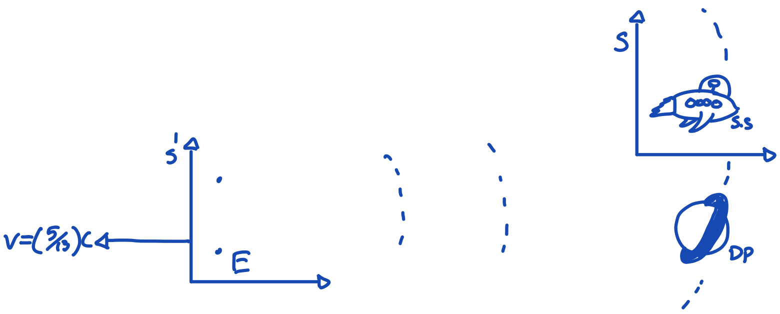
$\underline{E_1}$



$\underline{E_2}$



$\underline{E_3}$



b.) Length RT S.S

Since E and DP are moving

$$d = D \cdot \sqrt{1 - v^2/c^2}$$

$$d = 25\,c\cdot yrs \sqrt{1-(5/13)^2} = 25\,c\cdot yrs\,(12/13) = 23\ c\cdot yrs$$

$$d = 23\ c\cdot yrs$$

c.) Time for DP to arrive RT S.S

$$\Delta t = \frac{d}{v} = \frac{23\ c\cdot yrs}{(5/13)c} = 60\ yrs$$

$$t_E = 60\ yrs$$

d.) Acc. to S.S, what does E read when DP arrives?

$$\Delta t' = \Delta t \sqrt{1 - v^2/c^2} = 60 yrs \sqrt{1-(5/13)^2} = 60 yrs\,(12/13) = 55\ yrs$$

$$t_{ss} = 55\ yrs$$

6.)

a.) what is the Meson particles speed ?

$D = 10\,m$

$\tau = 1.25\times10^{-6}\,s$

$D = \frac{v\cdot\tau}{\sqrt{1-v^2/c^2}}$

$D\sqrt{1-v^2/c^2} = v\cdot\tau$

$D\sqrt{1-v^2/c^2} = (v/c)\cdot(\tau c)$

$D^2(1-v^2/c^2) = (v^2/c^2)(\tau^2c^2)$

$D^2 - D^2(v^2/c^2) = (v^2/c^2)(\tau^2c^2)$

$D^2 = D^2(v^2/c^2) + (v^2/c^2)\tau^2c^2$

$D^2 = v^2/c^2\,(D^2+\tau^2c^2)$

$\frac{D^2}{D^2+\tau^2c^2} = v^2/c^2$

$v/c = \sqrt{\frac{D^2}{D^2+\tau^2c^2}}$

$v/c = \sqrt{\frac{D^2}{D^2+\tau^2c^2}} = \sqrt{\frac{10^2}{10^2+(1.25\times10^{-8}s)^2(3.00E8\,m/s)^2}} = 0.936$

$v/c = (117/125)\,c$

b.) lifetime according to scientists ?

$\Delta t = \frac{\Delta t'}{\sqrt{1-v^2/c^2}} = \frac{1.25\times10^{-8}\,s}{\sqrt{1-(117/125)^2}} \approx 3.55\times10^{-8}\,s$

$t_s = 3.55\times10^{-8}\,s$